

Two new species of deeper dwelling *Apogon* (Perciformes: Apogonidae) from Micronesia and South Pacific Ocean

THOMAS H. FRASER¹ & JOHN E. RANDALL²

¹ Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, FL 34236-1096 USA

² Bishop Museum, 1525 Bernice St., Honolulu, HI 96817-2704 USA

Abstract

Apogon brevispinis is described from two specimens, the larger of which is missing the caudal peduncle, collected at the Austral Islands. This species has a tiny first dorsal-fin spine (5-8% of the third dorsal-fin spine length), 18-19 well-developed gill rakers on first arch, 5 predorsal scales, elongated last soft dorsal and anal fin-rays, 14 circumpeduncular scales, 5 broad tan-brown stripes alternating with 5 narrow whitish stripes, and an irregular dark caudal peduncle mark. *Apogon regula* is described from five specimens collected in Guam and the Carolina Islands. This species has a longer first dorsal-fin spine (10-15% of the third dorsal-fin spine length), 13-14 well-developed gill rakers on first arch, 4 predorsal scales, 12-13 circumpeduncular scales 5 broad golden-brown stripes alternating with 4 narrow whitish stripes, and dark brown broad stripes on the upper and lower caudal peduncle.

Key words: Apogonidae, cardinalfish, *Apogon*, *Apogon brevispinis*, *Apogon regula*, new species

Introduction

Cardinalfishes in *Apogon* are known to live at depths of more than 200 meters. Below about 30 meters collection by SCUBA gear becomes relatively rare because of the dangers of nitrogen narcosis. We describe two of these deeper dwelling species in the subgenus *Ostorhinchus*. There are a number of different species groups, based on variations of color patterns, slight differences in body and caudal-fin shape, gill-raker and pectoral fin-ray counts for which the limits are gradually becoming better defined. These two species belong to a large group of species, often difficult to identify, with 3 or more head and body stripes (blackish, brownish or yellowish in life). We expect both of these species to be more widely distributed than records suggest.

Methods

Methods of taking and recording meristic data and measurements are given in Fraser & Lachner (1985). All measurements are in millimeters to the nearest 0.1mm. All measurements are standard length unless otherwise noted. All proportions are based on standard length. All x-ray photographs are in data files maintained by the first author. Acronyms used in the lists of materials for institutions and collections cited, follow usage given in Leviton et al., (1985) and Eschmeyer (1998). Field numbers are as follows: GVF, George Vanderbilt Foundation, JTW, Jeffery T. Williams, VGS, Victor G. Springer.

Apogon brevispinis new species

(Figures 1A, 2A & Table 1).

Holotype: BPBM 13723; 35.1 mm SL; Austral Is., Rurutu, west side off Areva; 22 Feb 1971; 46-58 m; collected by J. Randall, D. Cannoy, D. Devaney, R. McNair and J. Haywood; x-ray.

Paratype: USNM 371776; 62mm+ (damaged); same data as holotype; x-ray.

Other material: Rangiroa; 9 Apr 1971; 53 m; ~ 32-mm SL; color slide; lost specimen.

Comparative material: *Amia angustata* Holotype USNM 68399 (66.8mm SL); Philippine Is., Malanipes I., east Zamboanga; x-ray. *Apogon angustatus* CAS 56542 (2 specimens, 27-44mm SL); Solomon Is., Santa Ana I.; 1 Apr 1985. USNM 350510 (9); Vanuatu, Epi I., 16°47'13"S 168°21'36"E; JTW 96-46; 16 Jun 1996; 1-10m. USNM 341663 (1); Tonga Is., Vava'u Group, Ovaka I., 18°44'31"S 174°6'36"W; JTW 93-42; 17 Nov 1993; 0.1-10m. USNM 334426 (1); Tonga Is., Tongatapu Group, Atata I., 21°1'10"S 125°13'40"W; JTW 93-10; 28 Oct 1993; 10-20m. USNM 341662 (1); Tonga Is., Vava'u Group, Nuku I., 18°42'54"S 174°2'36"W; JTW 93-48; 19 Nov 1993; 1-3m. USNM 224630 (2); Caroline Is., Ponape, 7°35'N 158°11'50"E; VGS 80-8; 8 Sep 1980; 0.1-15m. CAS 84148 (6, 19-54); Line Is., Kiritimati Atoll, 1°55'45"N, 157°;28'15"W; GVF 51; 26 Aug 1951. USNM 325626 (10); Samoa, Tutuila I.; 20 Nov 1975; 20m. CAS 80789 (5, 33-48); American Samoa, Tutuila I.; 1 Aug 1990; CAS 80822 (48-62); American Samoa, Tutuila I.; 3 Aug 1990. *Apogon nigrofasciatus* Holotype USNM 142230 (58); Marshall Is., Bikini Atoll, Yuroch I., 13 Jul 1946; x-ray. Palau Is: BPBM 7423 (1, 60); Babelthaup I.; 29 Sep 1966. BPBM 9808 (2, 43-47); Ngemelis I.; 23 Apr 1970. CAS 56569 (2, 34-43); New Guinea, Louisiade Arch.; 4 Apr 1985. USNM 341717 (14, 15-67); USNM 212730 (5, 44-55); Marshall Is., Taka Atoll; Oct 22 1964; 0-9m; x-rayed. Tonga Is., Ha'apai Group, Uoleva I., 19°51'36"S 174°25'06"W; 11 Nov 1993; JTW 93-28; 0.3-2m. USNM 167315 (2, 40-48); Gilbert Is., Onotoa. USNM 346982 (2, 45-51); Vanuatu, Erromango, 18°56'34"S 168°59'34"E; JTW 96-8; 26 May 1996; 27-30m. USNM 346983 (2, 46-53); Vanuatu, 18°49'39"S 169°00'23"E; JTW 96-6; 25 May 1996; 10-15m. USNM 358449 (1, 48); Vanuatu, Epi I., 16°35'34"S 168°09'25"E; JTW 96-42; 15 Jun 1996; 14-24m. USNM 212749

(2, 45-46); Society Is., Tahiti; 3 May 1957. *Apogon novemfasciatus* CAS 30751 (1, 37); Samoa, Pago Pago; 14 Nov 1946. CAS 43327 (12, 36-63); Marshall Is., Enewetak Atoll; 23 Feb 1974. CAS 53323 8 (36-51); Philippines, Luzon I., Layia; 29 Jun 1948. CAS 84107 (39,21-73); Pulau, 13°22'36"N, 144°38'53"E; GVF 1840; 12 Oct 1958. CAS 84139 3 (46-64); Guam, 13°28'42"N,144°45'04"E; GVF 1854; 25 Jan 1959. CAS 84149 (22, 34-65); Yap Is., Gagil I., 9°30'26"N, 138°10'20"E; GVF 1919; 24 Dec 1959. CAS 84188 (5, 37-50); Fiji, Viti Levu I., 18°13'10"S, 177°43'12"E; GVF 2010; 9 Aug 1959. CAS 209954 (3, 53-61); Fiji, Viti Levu I., 30 May 1999. *Apogon relativus* BPBM 11699 (1, 72); Fatu Hiva, Marquesas Is.; 19 Apr 1971. USNM 359800 (8, 27-74); Marquesas Is.; 9 Sep 1956. CAS 124514 (1, 80); Nuka Hiva Island; 7 Feb 1929. *Apogon sinus* BPBM 12811 (1, 69); Marquesas Is.; 19 May 1971; BPBM 10356 (2, 81-85); Marquesas Is.; 27 Nov 1955; CAS 211006 (2, 43-56); Marquesas Is.; 25 Apr 1971; USNM 359801 (2, 50-66); Marquesas Is.; *Apogon taeniophorus* Syntypes BMNH 1908.3.23.90-92 (3, 42-75); Maldives. USNM 341782 (8); Tonga Is., Vava'u Group, Nuku I., 18°42'54"S 174°2'36"W; JTW 93-48; 19 Nov 1993; 1-3m. USNM 346986 (11); Vanuatu, Erromango, 18°49'39"S 169°00'23"E; JTW 96-7; 25-26 May 1996; 1m. USNM 212706 (2); Howland I.; F-26; 11 Oct 1963. USNM 212707 (1); Howland I., F-140; 12 Feb 1964. USNM 212699 (1); Line Is. Fanning, I.; 3 Jul 1965. USNM 262326 (7); Fiji Is., Kandavu I., 18°57'S 178°17'E; VGS 82-21; 11 May 1982; 2m.

Diagnosis. A species of *Apogon* (*Ostorhinchus*) with alternating golden-brown and white stripes on head and body in life, white stripe extending onto last two anal rays; irregular darkish caudal peduncle mark; tiny first dorsal-fin spine, 5-8% of third dorsal spine length; 14 circumpeduncular scales; slightly elongated last dorsal and anal rays; 18-19 well developed gill rakers on first arch.

Description. For general body shape see Figs. 1A and 2A. Following proportions are percent standard length, Holotype: greatest body depth 37.0; head length 40.5; eye diameter 14.5; snout length 9.1; bony interorbital width 7.7; upper-jaw length 21.1; caudal peduncle depth 15.9; caudal peduncle length 25.4; first dorsal-fin spine length 2.0; second dorsal-fin spine length 11.1; third dorsal-fin spine length 25.1; fourth dorsal-fin spine length 21.6; spine in second dorsal fin 18.5; first anal-fin spine length 3.4; second anal-fin spine length 17.1; pectoral-fin length 27.1; pelvic-fin length 25.1. First dorsal-fin spine length 7.9 % of third dorsal-spine length (paratype 4.8%).

Dorsal fin VII-I,9 with tiny first spine and third spine much thicker than second or fourth, last soft ray as long as preceding ray; anal fin II,8, with last anal fin-ray longer than preceding ray; pectoral fin 14-14; pelvic fin I,5; principal caudal rays 9 + 8; pored lateral line scales 24; transverse scale rows above lateral line 2; transverse scale rows below lateral line 6; median predorsal scales 5; circumpeduncular scale rows 14 (5 + 2 + 7).

Teeth villiform, in several rows on the premaxilla; 2-3 rows becoming 1 row on side of dentary; 1-2 long rows on the palatine; 1 row on vomer; none on ectopterygoid, endopterygoid or basihyal. Rudiments and gill rakers on first arch (Table 1), 3 rudiments and 3 gill

rakers on upper arch, 2 rudiments and 15 gill rakers on lower arch of holotype, 3 rudiments and 3 gill rakers on upper arch, 1 rudiment and 16 gill rakers on lower arch of paratype, total gill rakers and rudiments 23. Second arch with 2 rudiments and 16 short rakers.

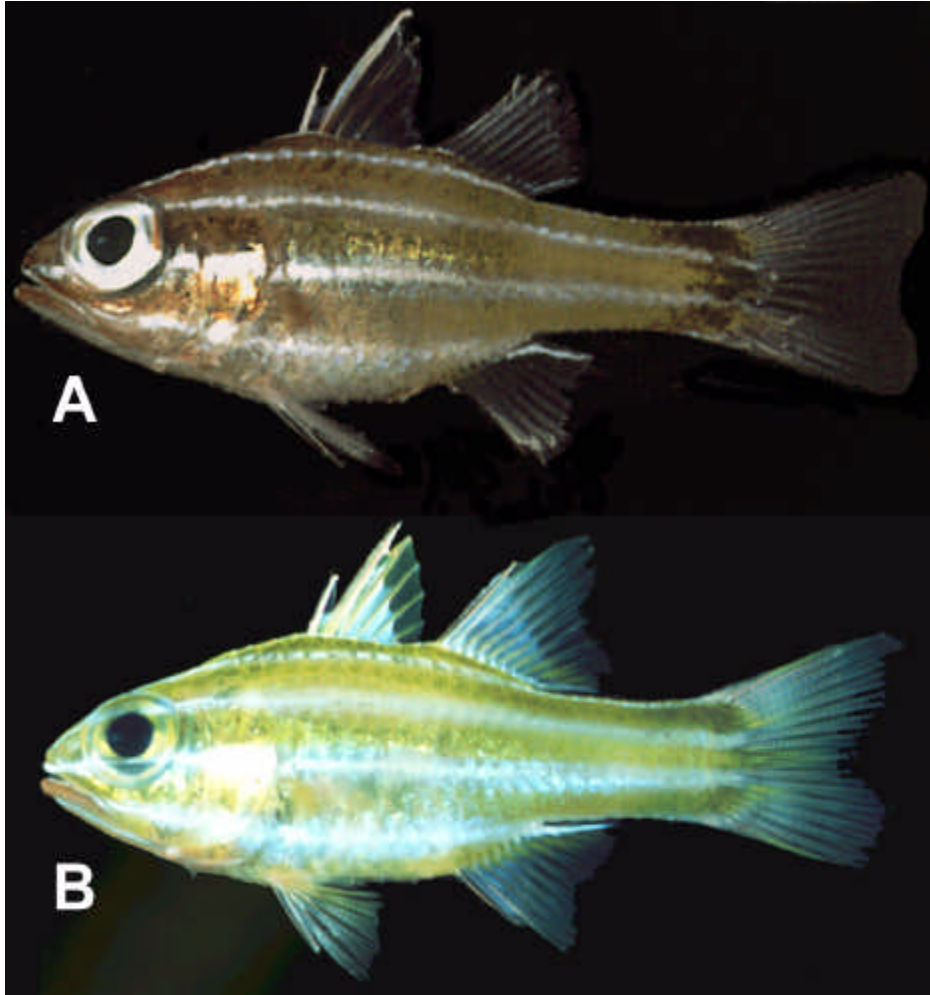


FIGURE 1. A. *Apogon brevispinis*, about 32 mm SL, from Rangiroa (photo J. E. Randall) B. *Apogon regala*, BPBM 6955, paratype, 36.4 mm SL, Guam (photo J. E. Randall).

Vertebrae 10 + 14. Five free hypurals, 1 pair of slender uroneurals, 3 epurals, a free parhypural. Three supraneurals, 2 supernumerary spines on first dorsal pterygiophore. Basisphenoid present. Supramaxilla absent. Posttemporal serrate (3-5) on posterior margin. Preopercle ridge smooth, edges serrate on posterior and ventral margins. Infraorbital edge smooth.

TABLE 1. Gill-raker counts on first gill arch of selected dark-striped species of *Apogon* for specimens from the Pacific Ocean.

Species	Upper rudiments				Upper gill rakers				Upper arch		
	1	2	3	4	2	3	4	4	5	6	
<i>brevispinis</i>			2			2				2	
<i>regula</i>			3		5				5		
<i>angustus</i>		4	38	1	39	4		1	40	2	
<i>relativus</i>			10		10				10		
<i>nigrofasciatus</i>	4	25	26			46	9	1	22	32	
<i>novemfasciatus</i>		35	20		4	51			39	16	
<i>sinus</i>		7			7			7			
<i>taeniophorus</i>		4	30		33	1		3	31		

Species	Lower rudiments				Lower gill rakers								Lower arch						
	1	2	3	4	9	10	11	12	13	14	15	16	12	13	14	15	16	17	18
<i>brevispinis</i>	1	1											1	1					2
<i>regula</i>		2	3			2	3							4	1				
<i>angustus</i>		5	29	9		6	32	4	1					4	32	6	1		
<i>relativus</i>			4	6			8	2								2	8		
<i>nigrofasciatus</i>		19	30	6					19	32	4					1	28	24	2
<i>novemfasciatus</i>	1	29	25				24	30	1						6	42	7		
<i>sinus</i>		1	6			6	1							7					
<i>taeniophorus</i>			16	17		6	24								18	15			

Scales on head, breast, nape and body ctenoid, pored lateral-line scales from posttemporal to base of hypural. Central pore canal on lateral-line scale with 2-3 pores on dorsal side, simple below with 1 pore. Ten pores around mouth (Figure 3); 3 bilateral pores above premaxilla, 1 below anterior nasal area along ventral edge of crease, 2 on ventral edge of lachrymal; 2 bilateral pores on dentary near symphysis, 1 mid-anterior, 1 ventral.

Life colors. From a color slide of a lost specimen (Figure 1A) about 32 mm SL taken at Rangiroa. Head and body with about 5 tannish-brown stripes alternating with 5 white stripes; first white stripe from nape at base of first dorsal fin (not clearly visible), extending to anterior base of second dorsal fin; second white stripe extending from nape along side onto dorsal side of caudal peduncle reaching procurrent caudal rays; third white stripe

extending from behind dorsal portion of eye along body to last caudal base scale just above pored lateral line; fourth white stripe begins on upper lip, onto snout, then from behind ventral portion of eye along body to last caudal base scale just above pored lateral line; fifth white stripe begins on lower portion of upper jaw, not reaching lower jaw, extending below pectoral-fin base onto base of anal fin at the fifth-sixth ray reaching tip of last anal ray; tannish-brown stripes wider than white stripes, tannish-brown stripes 2 and 4 from head, snout, and upper jaw on side extend past darker caudal base onto caudal-fin rays; ventral tannish-brown stripe from lower jaw reaching to anterior base of anal fin. Iris whitish. First dorsal membranes darkish; darkish stripes on second dorsal and anal fins, both fins with whitish bases on the preceding 3-4 rays reaching to the tips of the last rays. Melanophores concentrated near the base of caudal fin without the form of a simple bar or spot; other similar concentrations of melanophores in second and third tannish-brown stripes.

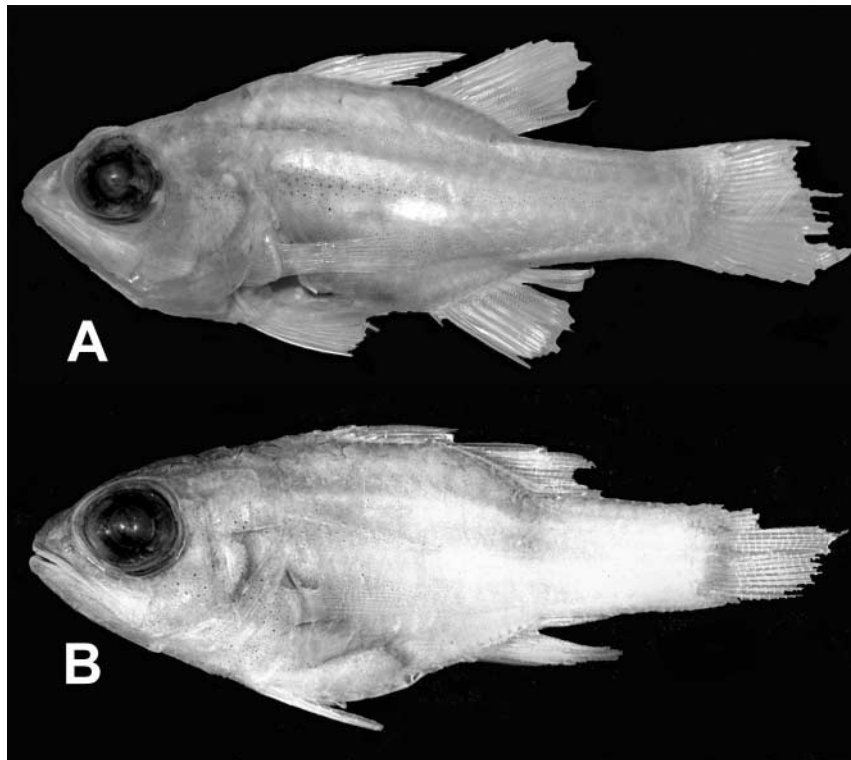


FIGURE 2. **A.** Holotype of *Apogon brevispinis*, BPBM 13723, 35.1 mm SL, Rurutu, Austral Islands. **B.** Holotype of *Apogon regula*, BPBM 24697, 38.4 mm SL, Condor Reef, Caroline Islands.

Color in alcohol. Holotype (Figure 2A) with stripe of faint melanophores on body behind eye reaching to anterior part of caudal peduncle, second faint stripe on side of

abdomen reaching to level of origin of anal fin, no other markings present on head, body otherwise pale; broad diffuse stripe in second dorsal fin with pale area below; stripe in anal fin rays at body anteriorly angled posteriorly to cover outer half of last 2 rays with pale area basally; all other fins pale. Paratype with uniform color on snout and nape, a band of few melanophores on cheek extending onto base of pectoral fin and then onto the abdomen reaching to about the posterior origin of the anal fin, another grouping of melanophores from the midline behind eye onto opercle and side of body, then fading out prior to posterior origin of anal fin, darkish stripe in the second dorsal fin pale above and below, darkish stripe in anal fin beginning at base of anal fin extending to tip of last 2 anal rays, pale above and below beginning about fourth anal ray, pelvic fin pale, dorsal fin pale. Peritoneum pale, holotype (but not paratype) with scattered melanophores; stomach and intestine blackish.

Distribution. Known from Rurutu Island in the Austral Islands and Rangiroa in the Tuamotu Archipelago.

Etymology. From the latin words *brevis* for short and *spina* for thorn, referring to the tiny first dorsal spine, as *brevispinis*.

Habitat. These specimens were collected on a 45°E coral slope with very little sand. The lack of additional material suggests that this species may usually live below the typical access of SCUBA gear assisted collections.

Remarks. Color patterns, gill raker and pectoral-fin ray counts, and shape of anal fin are used to help determine phenetic relationships within the subgenus *Ostorhinchus*. *Apogon brevispinis* is distinguished by its higher gill-raker counts (Table 1) from other dark-striped *Apogon*, except *A. nigrofasciatus* Lachner, 1953. In life, the dark stripes are blackish in *A. nigrofasciatus* and brownish in *A. brevispinis*. The last soft anal ray is slightly elongated, similar to the more elongated last anal ray of the very closely related *Apogon angustatus* (Smith & Radcliffe in Radcliffe, 1911), and *Apogon relativus* Randall, 2001, and to *Apogon novemfasciatus* Cuvier in Cuvier & Valenciennes, 1828. A whitish stripe extending onto the last 1 or 2 soft rays of the dorsal and anal fins may also be of use in grouping the above species as well as *Apogon cookii* Macleay, 1881, and *Apogon taeniophorus* Regan, 1908. The whitish stripes are absent in the soft dorsal and anal fins of *Apogon sinus* Randall, 2001. Randall & Lachner (1986) discussed distinguishing characteristics of a number of similar looking dark-striped species as part of their redescription of *Apogon nigrofasciatus* that have both sets of characteristics.

The tiny, easily overlooked, first dorsal spine present in *Apogon brevispinis* is similar to the tiny first dorsal spine in *Apogon fasciatus* Shaw in White, 1790, a species with a much different color pattern. Some species of the *Apogon cyanosoma* complex with generally yellowish stripes, which are very faint or lacking in preserved material, also have an elongated anal-fin ray.

***Apogon regula* new species**

(Figures 1B, 2B & Table 1).

Holotype: BPBM 24697, 38.4 mm SL, Caroline Is., Condor Reef, 24 March 1972, R/V Townsend Cromwell, Cruise 57, trawl or dredge, 55 m. x-ray

Paratypes: USNM 371777 (1, 35.9 mm SL); same data as holotype. BPBM 6955; (3, 22.3-36.4); Guam, south of NCO beach; 23 June 1968; 27-30 m; J. E. Randall, H. Kami, A. J. Stark and G. E. Fosse; x-ray.

Comparative material: see list under *Apogon brevispinis*.

Diagnosis. A species of *Apogon* (*Ostorhinchus*) with alternating golden-brownish and white stripes on head and body in life, broad dark brown stripes on upper and lower caudal peduncle, midlateral stripe without a developed spot, whitish stripe extending onto last 2 anal rays; elongated last dorsal and anal rays; 12-13 circumpeduncular scales; 13-14 well-developed gill rakers on first gill arch.

Description. For general body shape see Fig. 1B. Value for holotype followed by values for paratypes in parentheses; proportions given as percent of standard length: greatest body depth 36.5 (36-38); head length 40.6 (39-43); eye diameter 16.4 (15-16); snout length 9.6 (9-10); bony interorbital width 7.3 (7); upper-jaw length 20.8 (20-22); caudal peduncle depth 16.1 (15-18); caudal peduncle length 26.8 (23-27); first dorsal-fin spine length 2.6 (2-3); second dorsal-fin spine length 8.6 (10); third dorsal-fin spine length 20.3 (21-22); fourth dorsal-fin spine length 18.5 (17-20); spine in second dorsal fin 15.9 (17); first anal-fin spine length 2.6 (3-4); second anal-fin spine length 15.3 (14-15); pectoral-fin length 24.7 (23-25); pelvic-fin length 21.3 (23). First dorsal spine 12.8 % of third dorsal spine length (paratypes 10.0-14.8%).

Dorsal fin VII-I,9 with third spine much thicker than second or fourth, last soft ray as long as preceding ray; anal fin II,8, with last anal fin-ray longer than preceding ray; pectoral fin 14-14; pelvic fin I,5; principal caudal rays 9 + 8; pored lateral-line scales 24; transverse scale rows above lateral line 2; transverse scale rows below lateral line 6; median predorsal scales 4; circumpeduncular scale rows 12 (5 + 2 + 5), 13 in two paratypes;

Teeth villiform, band of teeth on premaxilla; band becoming 1 row on side of dentary; 1 row on palatine; 1 row on vomer; none on ectopterygoid, endopterygoid or basihyal. Rudiments and gill rakers on first arch (Table 1), 3 rudiments and 2 gill rakers on upper arch, 2 rudiments and 12 gill rakers on lower arch for holotype, 3 rudiments and 2 gill rakers on upper arch, 2-3 rudiments and 11-12 gill rakers on lower arch for the paratypes, total gill rakers and rudiments 19-20. Second arch with 2 + 13 rudiments and short gill rakers.

Vertebrae 10 + 14. Five free hypurals, 1 pair of slender uroneurals, 3 epurals, a free parhypural. Three supraneurals, 2 supernumerary spines on first dorsal pterygiophore. Basisphenoid present. Supramaxilla absent. Posttemporal edge damaged on holotype, with 2-4 serrations on posterior margin for paratypes. Preopercle ridge smooth, edges serrate on posterior and ventral margins. Infraorbital edges smooth.

Scales on head, breast, nape and body ctenoid, pored lateral line scales from posttem-

poral to base of hypural. Central pore canal on lateral-line scale with 2 pores on dorsal side, simple below with 1 pore. Ten pores around mouth (Figure 3); 3 bilateral pores above premaxilla, 1 below anterior nasal area along ventral edge of crease, 2 on ventral edge of lachrymal; 2 bilateral pores on dentary near symphysis, 1 mid-anterior, 1 ventral.

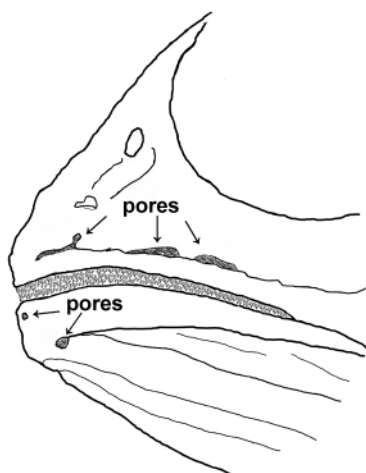


FIGURE 3. Diagrammatic location of large pores present on the head of *Apogon brevispinis* and *Apogon brevispinis*. Paratype of *Apogon brevispinis* illustrated (USNM 371776). Both species have a posterior notch associated with the anterior pore below the nasal area. Pores on the crease of skin associated with the lachrymal above the premaxilla and nasal area are not visible laterally and are best seen holding specimens inverted.

Life colors. From a color slide of a paratype (Figure 1B), head and body with alternating golden-brownish (5) and whitish (4) stripes (a fifth white stripe may be present but no traces are visible); first whitish stripe beginning on nape extending onto upper body, ending on caudal peduncle near base of procurrent rays; second whitish stripe from snout through iris above pupil, continuing above mid-line stripe crossing pored lateral-line scales about in line with seventh soft- dorsal ray, ending at base of caudal fin; third narrow whitish stripe from tip of upper lip, along snout and through iris below pupil broadening on opercle, extending on side of body to base of caudal fin; fourth white stripe from dorsal edge of maxilla along lower part of gills, side of abdomen and onto tip of last anal ray; brownish stripe along dorsum ending near posterior base of second dorsal fin; golden-brownish stripe beginning on nape, through part of upper iris, then extending along head and side of body onto upper side of caudal peduncle becoming dark-brownish to base of caudal fin, then golden-brownish on base of caudal-fin rays; golden-brownish stripe from snout and continuing behind pupil along midline of body to base of caudal fin, but not extending onto caudal fin; golden-brownish stripe from mid premaxilla through lower part

of iris and opercle, pectoral fin base, side of body, onto lower caudal peduncle becoming dark-brownish to base of caudal fin, then golden-brownish on base of caudal-fin rays; lower lip golden-brownish, continuing onto maxilla, gill membranes, abdomen, base of anal fin and finally onto last few anal rays; pectoral, pelvic and caudal fin without markings; anal and dorsal fin without markings distally; brownish and whitish stripes on last 3-4 anal rays; faint brownish stripe in second dorsal fin.

Color in alcohol. Holotype (Figure 2B) with body uniform, without obvious stripes, melanophores on cheek, opercle, base of pectoral fin and extending onto anterior half of sides, no other markings on head or body; basicaudal region with melanophores forming darker area, all second dorsal and anal fins with melanophore pattern suggestive of stripe in basal portion of fin-rays; other fins pale. Peritoneum pale with small spots of melanophores; stomach and intestine blackish.

Paratypes: USNM 371777 similar to holotype. Two largest paratypes in BPBM 6955 with faint melanophores in striped pattern on body; smallest without faint striped pattern on body, all fins pale. Some melanophores on head and opercular region of all specimens.

Distribution. Known from deeper waters of Guam and Condor Reef in the Caroline Islands.

Etymology. The Latin noun *regula*, treated as a noun in apposition, meaning ruler, measure or pattern, in this case a re-occurring pattern of alternating 3 broad (darker) stripes and 3 (lighter) narrow stripes on the caudal peduncle shared with many dark-striped species of *Apogon*.

Remarks. This species may be confused with *Apogon angustatus* and *Apogon nigrofasciatus*. *Apogon regula* can be distinguished from *Apogon nigrofasciatus* by having slightly lower gill raker counts, an elongated last anal ray and brownish rather than blackish wider body stripes. The blackish stripes on the head and body of *Apogon angustatus* are crisp, about the same width as the whitish stripes and there is a dark basicaudal spot, all unlike *Apogon regula*.

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